

CLAIMS

What is claimed is:

1 1. A hot swappable pulse width modulation switching
2 regulator controller comprising:
3 a hot swap transistor;
4 a pulse width modulation switching regulator controller
5 circuit coupled in series with the hot swap transistor;
6 a hot swap circuit coupled to a control terminal of the
7 hot swap transistor;
8 the hot swap circuit, when the hot swap circuit and the
9 series combination of the hot swap transistor and the pulse
10 width modulation switching regulator controller circuit are
11 coupled to an active source of power, turning on the hot swap
12 transistor at a controlled rate;
13 whereby power is applied to the pulse width modulation
14 switching regulator controller circuit at a controlled rate
15 in spite of the sudden application of power to the hot
16 swappable pulse width modulation switching regulator
17 controller;
18 the pulse width modulation switching regulator
19 controller circuit and the hot swap circuit being in a single
20 integrated circuit.

1 2. The hot swappable pulse width modulation switching
2 regulator controller of claim 1 wherein the controlled rate
3 is a predetermined rate of voltage increase.

1 3. The hot swappable pulse width modulation switching
2 regulator controller of claim 1 wherein the controlled rate
3 is a rate limiting a current through the hot swap transistor
4 to a predetermined maximum current.

1 4. The hot swappable pulse width modulation switching
2 regulator controller of claim 1 wherein the controlled rate
3 is a predetermined rate of voltage increase, or a rate
4 limiting a current through the hot swap transistor to a
5 predetermined maximum current, whichever occurs first.

1 5. The hot swappable pulse width modulation switching
2 regulator controller of claim 1 wherein the hot swap
3 transistor is part of the integrated circuit.

1 6. The hot swappable pulse width modulation switching
2 regulator controller of claim 1 wherein the hot swap
3 transistor is a discrete transistor.

1 7. The hot swappable pulse width modulation switching
2 regulator controller of claim 1 wherein the pulse width of
3 the pulse width modulation switching regulator controller

4 circuit starts with a minimum pulse width and increases until
5 the output of a pulse width modulation converter coupled
6 thereto is within regulation.

1 8. The hot swappable pulse width modulation switching
2 regulator controller of claim 7 wherein the pulse width
3 modulation switching regulator controller circuit will start
4 when the voltage applied to the pulse width modulation
5 switching regulator controller circuit approaches the voltage
6 of the source of power.

1 9. The hot swappable pulse width modulation switching
2 regulator controller of claim 8 wherein the pulse width
3 modulation switching regulator controller circuit will not
4 start until the voltage applied to the pulse width modulation
5 switching regulator controller circuit exceeds a
6 predetermined voltage.

1 10. The hot swappable pulse width modulation switching
2 regulator controller of claim 1 wherein the pulse width
3 modulation switching regulator controller circuit will start
4 when the voltage applied to the pulse width modulation
5 switching regulator controller approaches the voltage of the
6 source of power.

1 11. The hot swappable pulse width modulation switching
2 regulator controller of claim 10 wherein the pulse width
3 modulation switching regulator controller will not start
4 until the voltage applied to the pulse width modulation
5 switching regulator controller exceeds a predetermined
6 voltage.

1 12. The hot swappable pulse width modulation switching
2 regulator controller of claim 1 further comprising a
3 switching converter coupled to the controller circuit and
4 wherein converter switching transistors are on the integrated
5 circuit.

1 13. The hot swappable pulse width modulation switching
2 regulator controller of claim 1 further comprising a
3 switching converter coupled to the controller circuit and
4 wherein converter switching transistors and the hot swap
5 transistor are on the integrated circuit.

1 14. The hot swappable pulse width modulation switching
2 regulator controller of claim 1 wherein the pulse width
3 modulation switching regulator controller further comprises
4 circuitry for providing a control output for control of
5 synchronous rectifiers on the secondary side of an isolation
6 transformer coupled to converter switching transistors on the

7 output of the pulse width modulation switching regulator
8 controller circuit.

1 15. A hot swappable pulse width modulation converter
2 comprising:
3 a hot swap transistor;
4 a converter output circuit; and,
5 an integrated circuit comprising
6 a pulse width modulation switching regulator
7 controller coupled in series with the hot swap
8 transistor, the output of the pulse width modulation
9 switching regulator controller being coupled to the
10 converter output circuit;
11 a hot swap circuit coupled to a control terminal of
12 the hot swap transistor;
13 the hot swap circuit, when the hot swap circuit and
14 the series combination of the transistor and the pulse
15 width modulation switching regulator controller are
16 coupled to an active source of power, turning on the hot
17 swap transistor at a controlled rate;
18 whereby power is applied to the pulse width modulation
19 switching regulator controller at a controlled rate in spite
20 of the sudden application of power to the hot swappable pulse
21 width modulation switching regulator controller.

1 16. The hot swappable pulse width modulation converter
2 of claim 15 wherein the controlled rate is a predetermined
3 rate of voltage increase.

1 17. The hot swappable pulse width modulation converter
2 of claim 15 wherein the controlled rate is a rate limiting a
3 current through the hot swap transistor to a predetermined
4 maximum current.

1 18. The hot swappable pulse width modulation converter
2 of claim 15 wherein the controlled rate is a predetermined
3 rate of voltage increase, or a rate limiting a current
4 through the hot swap transistor to a predetermined maximum
5 current, whichever occurs first.

1 19. The hot swappable pulse width modulation converter
2 of claim 15 wherein the hot swap transistor is part of the
3 integrated circuit.

1 20. The hot swappable pulse width modulation converter
2 of claim 15 wherein the hot swap transistor is a discrete
3 transistor.

1 21. The hot swappable pulse width modulation switching
2 regulator controller of claim 15 wherein the pulse width of
3 the pulse width modulation switching regulator controller

4 starts with a minimum pulse width and increases until the
5 output of the pulse width modulation converter is within
6 regulation.

1 22. The hot swappable pulse width modulation switching
2 regulator controller of claim 21 wherein the pulse width
3 modulation switching regulator controller will start when the
4 voltage applied to the pulse width modulation switching
5 regulator controller approaches the voltage of the active
6 source of power.

1 23. The hot swappable pulse width modulation switching
2 regulator controller of claim 22 wherein the pulse width
3 modulation switching regulator controller will not start
4 until the voltage applied to the pulse width modulation
5 switching regulator controller exceeds a predetermined
6 voltage.

1 24. The hot swappable pulse width modulation switching
2 regulator controller of claim 15 wherein the pulse width
3 modulation switching regulator controller will start when the
4 voltage applied to the pulse width modulation switching
5 regulator controller approaches the voltage of the active
6 source of power.

1 25. The hot swappable pulse width modulation switching
2 regulator controller of claim 24 wherein the pulse width
3 modulation switching regulator controller will not start
4 until the voltage applied to the pulse width modulation
5 switching regulator controller exceeds a predetermined
6 voltage.

1 26. The hot swappable pulse width modulation switching
2 regulator controller of claim 15 comprises a single
3 integrated circuit plus the transistor as a discrete
4 transistor.

1 27. The hot swappable pulse width modulation switching
2 regulator controller of claim 15 wherein the pulse width
3 modulation switching regulator controller further comprises
4 circuitry for providing a control output for control of
5 synchronous rectifiers on the secondary side of an isolation
6 transformer coupled to converter switching transistors on the
7 output of the pulse width modulation switching regulator
8 controller.

1 28. A method of operating a switching converter having
2 a switching converter controller comprising:

3 a) when voltage is first supplied to the converter,
4 increasing the voltage applied to the switching converter
5 controller at a controlled rate;

6 b) when the voltage applied to the switching converter
7 controller approaches the voltage supplied to the converter,
8 starting the switching converter controller with a minimum
9 pulse width; and,

10 c) increasing the pulse width until the converter comes
11 into regulation.

1 29. The method of claim 28 further comprising
2 preventing starting of the switching converter controller
3 until the voltage applied to the converter exceeds a
4 predetermined voltage.

1 30. The method of claim 29 wherein the switching
2 converter has an isolated output and further comprising
3 generating a control signal for synchronizing synchronous
4 rectifiers in the isolated output circuitry.